ELECTROLESS NICKEL AND ELECTROLESS KROME PLATING

Acid Nickel Process: 5-7% phosphorus

These instructions now cover the Nickel and the Krome kits. Electroless Krome is a nickel/cobalt alloy, harder and bluer than nickel. Where these instructions refer to Electroless Nickel, this also means Electroless Krome. The only difference in the kits is the part A component, which, in the case of Krome, has the cobalt additive. You may use parts B & C for either type of plating, as they are completely interchangeable.

Electroless nickel/krome plating requires no anodes, power supply or electrical connection of any kind. The process simply involves mixing together some solutions, heating them to just off the boil, and then immersing the part to be plated. An auto-catalytic electrochemical reaction takes place and the nickel is evenly deposited all over the part being plated. The thickness of the plate will depend on the duration of immersion. To stop the reaction, the part is removed from the solution, which is allowed to cool before storing for later reuse.

Commercial electroless nickel platers usually employ full time chemists to make additions to the solution. This is a time consuming activity for a small operation and is not cost effective. Our system is designed around the KISS -'Keep It Safely Simple' principal, so you will not have to 'titrate' and mess around with this technicality. We have developed a straightforward way of estimating the nickel depletion of the bath, and fresh additions can easily be made to prolong the life of the solution. The procedure is much like balancing your chequebook.

The brightness of the plate will, to some extent, depend on the degree of polish existing on the part. The higher the shine initially, the brighter the plate. Surfaces requiring shiny finishes should be done in fresh batches of solution, otherwise they may have to be buffed to obtain a high gloss. The duller finishes resemble cadmium or Butler nickel, so are of great value to most vehicle restorers. Numerous variations can be achieved by changing the surface finish prior to plating.

Electroless nickel plating is not new; it has many applications in industry. Because the system plates evenly over all areas of the part, even down tubes and holes, it is frequently used for firearms and small hand tools. It is ideally suited for coating extrusion dies to assist in mold release and protection of the surface. For the motorcycle restoration enthusiast, electroless nickel has a great application for evenly plating the air-cooling fins on many engine blocks, particularly older Indians and Harleys.

Fortunately, electroless nickel is a fairly safe material, nevertheless, there are heavy metals (nickel) in the solution and this should not be disposed of carelessly. Our kits have a special system included to 'plate out' the excess nickel, rendering the rest of the solution harmless, enabling you to dispose of down a drain, or as per your local regulations.

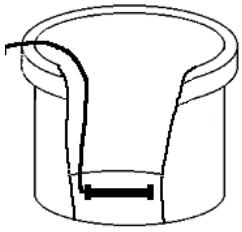
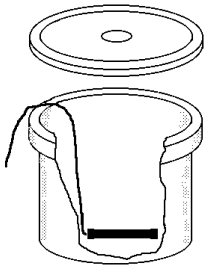
The system consists of 3 main ingredients, parts A, B & C.

Mix parts A & B with distilled water to make up the initial solution. As this is depleted of nickel, further additions of part A and part C are made to keep the solution stable and plating brightly.

What is a ‘Nickel Credit’?

It is the surface area in square inches, multiplied by the plating time in minutes.
Ie: To plate a part that has a total surface area of 10 square inches, with a light decorative plate, we need to plate for 15 minutes to obtain 0.0025” thickness
Therefore, 10 x 15 = 150 credits

0.5 oz of Part A added to 1 oz part C will make enough Replenisher to supply 240 credits

PROCEDURE	SETUP	OPERATING PARAMETERS	EQUIPMENT	SAFETY
1. SURFACE PREPARATION	Buff & Polish for a mirror finish. Bead Blast for a 'flat' finish. Nylon Abrasive wheel buff for a 'scratched brush' look.			
2. DEGREASING		140- 200 deg F No agitation 5 mins immersion 12 oz SP Degreaser 3 gal Distilled water	1 x 5 gal tank 1 x tank lid 1 x lid ring 1 x 200f heater 1 x 2lb SP Degreaser	Wear rubber gloves and goggles. Do not ingest
1. RINSE IN DISTILLED WATER SPRAY 2. WATER BREAK TEST 3. CALCULATE TOTAL SURFACE AREA AND PLATING TIME 4. CALCULATE CREDITS 5. CHECK for MAXIMUM LOAD 1.25 pint plating solution = 15 sq inches of plating surface area MAXIMUM! 6. CHECK for COPPER ALLOY – MUST BE ACTIVATED BY TOUCHING WITH STEEL for 2-5 mins when plating 7. PREMIX REPLENISHER if NEEDED				
3. Tank Makeup		195 deg F No agitation Immersion time depends on plating thickness Per 1.25 pints of plating solution required: 1 oz A, 3 oz B, 16oz Distilled water (makes 20 fl oz = 1.25 pints) MARK TANK WITH LIQUID LEVEL NOW	1 x 300W heater 1 x plastic tank 1 x tank lid (1 x tank ring) Mist balls	Wear rubber gloves and goggles. Do not ingest

4. Plating Times

Time	Application	Plate Thickness
15 mins	Indoor items, decorative etc.	0.00025 "
30 mins	Hand tools, guns, nuts & bolts, brackets	0.0005 "
60 mins	Marine, motorcycle, car or outdoor fitting	0.001 "

Tank Size In pints	MAXIMUM LOAD in sq"	NICKEL CREDITS	REPLENISH after 20% credit loss	REPLENISHER Amounts required to make up enough to replenish 20% loss of credits in tank	
				Part A	Part C
1.25	15	450	90	0.1 oz	0.2 oz
5	75	1800	360	0.5 oz	1 oz
10	150	3600	720	1oz	2 oz
20	300	7200	1440	2 oz	4 oz
40	600	14400	2880	4 oz	8 oz

5. DETERMINE WHEN TO REPLENISH (after 20% credit loss) and HOW FREQUENTLY *
After replenishing:
6. TOP UP TANK TO ORIGINAL LEVEL WITH DISTILLED WATER.

*

- **Example 10 pint tank = 3600 credits = 720 @ 20% loss. Part is 150 sq" @ 30 mins = 4500 credits. Therefore tank needs to be replenished 4500/720 = 6 times in 30 minutes. (approx every 5 minutes)**
- **Example 10 pint tank = 3600 credits = 720 @ 20% loss. Part is 150 sq" @ 60 minutes = 9000 credits. Therefore tank needs to be replenished 9000/720 =12 times in 30 minutes. (approx every 2.5 – 3 minutes)**
- **Example 40 pint tank =14400 credits = 2880 @ 20% loss. Part is 150 sq" @ 30 mins = 4500 credits. Therefore tank needs to be replenished 4500/2880 = 1 times in 30 minutes (Balance of 1620 carried forward to next run)**
- **Example 40 pint tank = 14400 credits = 2880 @ 20% loss. Part is 150 sq" @ 60 minutes = 9000 credits. Therefore tank needs to be replenished 9000/2880 = 3 times in 30 minutes. (approx every 10 minutes) Balance of 360 credits carried forward to next run.**

Electroless Nickel Plating Troubleshooting

Problem	Cause	Remedy
No deposit	No current (or gassing from part Incorrect solution ratio Copper alloy not activated	Incorrect bath temperature, increase temp Dump solution and make up fresh batch Touch copper alloys with steel rod for 5-60 seconds until part starts to gas
Plate peels off or blisters	1. Poor preparation 2. Inadequate cleaning 3. Organic or metallic contamination 4. Improper zincating of aluminum	Check part with 'water break' test. Acid etch part. Check SP Degreaser is OK. Rework the part through the cleaning process Dump solution and make a fresh bath. Etch zincate off in mild acid, and re-zincate in fresh solution.
Pitted Plate	Impurities in solution Copious evolution of hydrogen gas	Dump solution and make up a fresh bath Surface are being plated should be reduced. If tank walls are gassing, they may be being plated. Clean tank
Rough Plate	Contamination of loose particles i.e.: dust nickel. Contaminated water used Particles of metal or soil on work	Filter solution through a doubled coffee filter. Discard solution and make up new batch using DISTILLED water Improve cleaning and rinsing process.
Dark deposits (esp. on low spots)	Zinc, lead or copper in solution	Plate out onto a dummy corrugated cathode. Zinc contaminants may show as alternating dark & lights areas. Air agitation must be on Adjust pH to 3.5 - 4.5
Streaks in Deposit	Gas streaks from position of work Poor agitation. Poor rinsing & or cleaning Metal & organic contamination Low surface area	Reposition work occasionally Agitate occasionally Improve cleaning and rinsing process Dump solution and make up fresh batch Increase the number of parts being plated
Poor corrosion/chemical resistance	Metallic contamination	Dump solution and make up fresh batch
Dark to black deposits	Metallic/organic contamination (usually caused by old zinc plate Bath imbalance	Dump solution and make up fresh batch Soak part in weak solution of muriatic acid to remove old zinc plate
Poor wear resistance	Low heat treatment temperature &/or short time	temperature and time cycle should be adjusted
Laminar deposits	Poor temperature	Keep temp within range
Frosted deposits	Low work load Metallic/organic contamination	Increase work load Dump solution and make up fresh batch
Poor Adhesion on Aluminum	Metallic/organic contamination Improper surface preparation Improper zincate or other pre-treatment Improper heat treatment Re-oxidation	Dump solution and make up fresh batch Improve cleaning and rinsing process Replace zincate bath heating time and temperature should be corrected Reduce transfer time from zincate to nickel
Dull or matte deposit	bath more than 25% used Metallic/organic contamination Poor quality substrate Low temperature	Make up fresh batch -or- buff the part to a shine solution and make up fresh batch Improve polishing etc Correct the temperature
Poor coverage, edge pullback & frosted edges	Improper cleaning &/or rinsing Metallic/organic contamination	Improve cleaning and rinsing process Dump solution and make up fresh batch
Plating solution turns white	Solution is depleted	Solution may be contaminated with alkaline drag in. Dump solution
Plating solution turns grey	Solution is decomposing	See above. Prevent drag in. Dump solution
Part A has hard deposit in bottom	Caused by solution temperature dropping below 50 deg F	The deposit contains the nickel, and MUST be re-dissolved into the solution Simply heat up the liquid to 150 F and stir until dissolved.

MAXIMUM LOAD
You may ONLY plate a maximum of **15 sq inches of surface area per 1.25 pints** of plating solution
If this amount is exceeded the bath will start to overwork and plating quality will seriously deteriorate.
Therefore if the part is 90 square inches, you need a MINIMUM of (90/15) = 6 x 1.25 pints of solution.
Of course, if your bath contains MORE solution, this is OK.

NICKEL CREDITS
To provide us with a simple way of logging the usage of the bath, we are going to award each unit of new solution with 'Nickel Credits'. These are the sum of the square inches multiplied by the plating time in minutes.
Each 1.25 pint of initial made up solution will plate:

7.5 square inches @ 1/1000 in 60 minutes.
15 square inches @ .0005" in 30 minutes.
30 square inches @ .00025' in 15 minutes.

A 1.25 pint bath has total Nickel Credits of 7.5 x 60= 450. Enter the 450 in the Nickel Credits column of the NICKEL CREDIT FORM and, just like balancing a checkbook account, enter the final balance in the balance column. (this is an account you cannot overdraw!)

NICKEL REPLENISHMENT
In practice, the additions of 'replenishment' should be made during the actual plating process at approximately every 10 minutes. The total amount of replenishment should be calculated and made up beforehand. Ideally, the bath should be maintained at 80% efficiency. Letting the nickel deplete below 70% level will accelerate rapid deterioration of the bath.
Failure to replenish the solution will result in the plate becoming dull and the bath eventually becoming out of balance and unusable.

The Nickel Bath Replenishment is a straightforward matter of adding more nickel from the Concentrate Part A, with an addition of Concentrate Part C.

If you have used the bath several times, you should keep a note of the time, surface area etc. using the log sheet. See blank form later in this section

REPLENISHING THE NICKEL PLATING BATH with Part A & Part C
As soon as your chart shows you have depleted the bath by approx 20%, add REPLENISHER MIXTURE of part A & C

ONLY ADD ENOUGH REPLENISHER TO BRING YOUR CREDITS UP TO 100%
You may add the replenishment solutions at any time. After a wait of approx. 20 seconds, to allow the solution to warm up to it operating temperature, top up the solution to the original waterline with DISTILLED WATER.

You may make as many as 10 (x 20%) COMPLETE additions of replenishment to the bath. Your additions will be noted on your 'Nickel Credits' form. After this, you should dispose of the solution and make a fresh bath with parts A & B.

A note on bath replenishment.

During the process of plating, a quantity of water will evaporate from the tank. Additions of DISTILLED WATER must be added periodically to maintain the correct dilution of the solution.
Make a note of the waterline when you first make up your solution. To make an addition, first, IF REQUIRED, add a quantity of REPLENISHMENT SOLUTION, then top up with distilled water.
It is always advisable to add small amounts of both distilled water and replenisher frequently, say every 5 minutes, as this will keep the bath from cooling and becoming unstable.

NICKEL CREDIT FORM

Surface Area in Square inches	Time In minutes	Nickel Credits	Balance Of Nickel Credits
1.25 pint = 7.5 sq " @	60 =	450	

Operating the Kit

A new type of ceramic heater is now available that will bring the solutions to a boil in a plastic tank. The tank is now a plastic tank. These heaters may take from 15-60 minutes to bring the solution to 200 deg f. To accelerate the process, you may remove the metal handle and microwave the solution in the plastic tank or a glass vessel.

DO NOT FORGET TO UNPLUG THE CERAMIC HEATING UNIT WHEN PLATING IS COMPLETED. IF LEFT UNATTENDED THE HEATER WILL EVAPORATE ALL SOLUTION, THEN MELT THE BUCKET AND MAY CAUSE A FIRE.

QuickTime™ and a TIFF (Uncompressed) decompressor are needed to see this picture.

WARNING! THIS HEATER MUST BE PLUGGED INTO A GFCI RECEPTICAL

Important. Any part made which contains copper; i.e. copper, brass, bronze, must be 'activated' by physically touching the part with a piece of steel for several seconds (5-30). Alternatively, the part may be suspended on a STEEL wire, which will activate the nickel/krome plating process. You should see the steel rod/wire bubbling gently. When the copper part begins to bubble, it has accepted the reaction and will continue to plate successfully.

Chemical Disposal Procedure

Add enough household ammonia to make the plating solution turn blue Heat to 170 deg f. Using 1 steel pad per litre of solution, immerse them into the solution.
Add the END concentrate at the rate of 20 ml per litre of solution.
Heat the bath to 190-205 deg F approx. 1-2 hours until the solution turns water white.
The solution is now drain safe and can be disposed of.

Tank Size In pints	**Quantity of Steel Pads**	**END** In Fl oz
1-2	1	0.5
8-12	4	4
24	12	8